

CRASH CUSHIONS

Crash cushions are installed for the following reasons:

1. To satisfy safety requirements in the gore area clean up program.
2. To protect vehicles from a hazard which cannot be removed.
3. To protect vehicles from a temporary construction hazard.

There are two classes of crash cushions:

- A. Non-redirectional crash cushions that allow a vehicle to penetrate the array.
- B. Redirectional units that redirect a vehicle when hit on the side.
 1. Energy Absorption - Hex-Foam
 2. Energy Absorption - GREAT (GUARD RAIL ENERGY ABSORBING TERMINAL)

The Hex-Foam and GREAT units dissipate energy using dry frangible cartridge cells. Non-redirectional crash cushions use frangible plastic barrels filled with varying quantities of sand.

The Districts determine the type of crash cushion considering the following factors:

The accident history at an obstacle determines the need for a redirectional unit.

Maintenance costs are greater for sand barrels when repeated hits are recorded.

Sand barrels scatter debris when impacted and are not to be used on elevated structures where the debris could fall on occupied space below.

Some Districts prefer certain types of crash cushions to minimize parts inventory and simplify repair procedure.

Sand barrels are usually selected to be placed in front of wide fixed objects and at irregularly shaped sites.

Temporary crash cushions can be either sand barrel arrays or a GREAT (Construction Zone).

Supersedes Memo to Designers 14-14 dated September 1980

In general, the selection and layout of crash cushions should meet the following requirements. See Attachments A, B, C, D and E.

1. The gore needed to accommodate crash cushions is shown on Attachment A.
2. Array A for the sand barrels shown in Attachment B is designed for 65 MPH impacts (for automobiles in the 1800-4500 pound range). This is the minimum number of sand barrels for use in an installation on a freeway. Other arrays are needed at larger obstructions.
3. Hex-Foam crash cushions with 10 bays are minimum for freeways. (See Attachment D.) Eight (8) bay units are to be used only at sites where normal speeds are always reduced.
4. The GREAT should be used only for very narrow gore or site conditions. Current repair costs appear higher than similar costs for Hex-Foam crash cushions. Though ten bay GREAT crash cushions are preferred, eight bay units are the minimum for use on freeways. For other State Highways where speeds are reduced six bays may be used.
5. When the type selection is in question, the initial crash cushion installation shall be sand barrels. Gore space should be reserved to accommodate a possible Hex-Foam unit in the future.
6. Temporary crash cushions placement is further explained in Memo to Designers 14-19, Temporary Railing.

For policy, "Temporary" is usually defined as the time period during a project construction period. Other use may be for emergency situations or those requiring Headquarter's Traffic review.

Standard details, similar to Attachments D and E, are available from the Walls and Railings Staff Specialist.

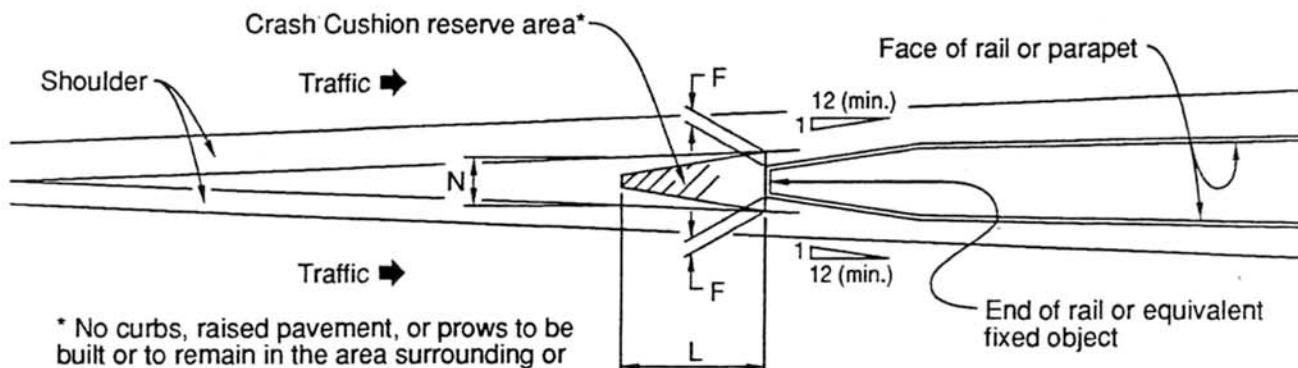


Philip C Warriner



Guy D. Mancari

RWB:jgf
Attachments



RESERVED AREA FOR GORES

Table 1**

Design Speed on Mainline (mph)	Dimensions for Crash Cushion Reserve Area (Feet)								
	Minimum			Unrestricted Conditions			Preferred		
	Restricted Conditions								
	N	L	F	N	L	F	N	L	F
70	6	28	2	8	45	3	12	55	4

** Copied from AASHTO, "Guide for Selecting, Locating and Designing Traffic Barriers".

Table 2

	Estimated Accident Cost (Thousands of Dollars)		
	Rural	Urban	Suburban
Fatal	608	534	551
Injury	15.2	103	12.2
PDO	2.5	2.5	2.5

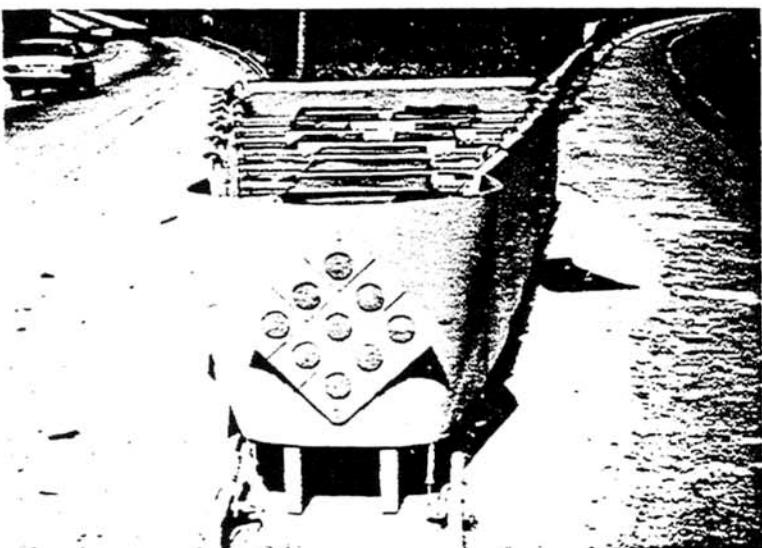
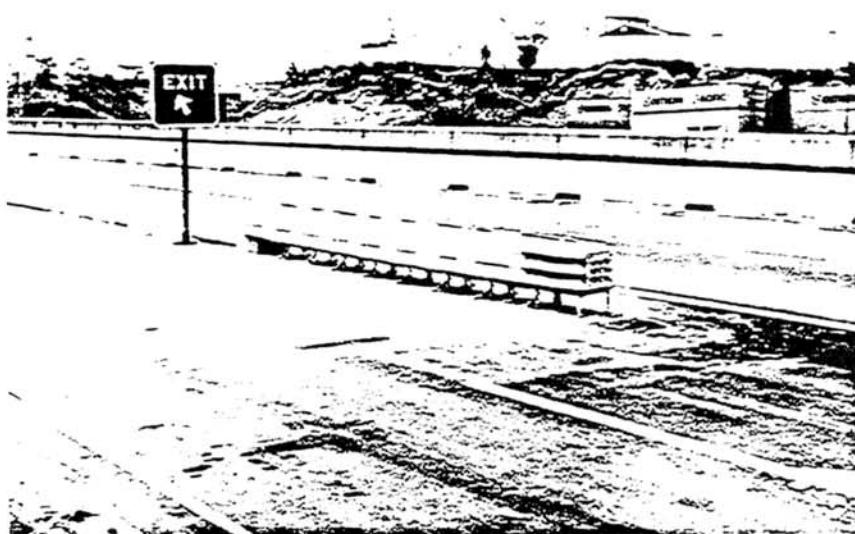
Note: This basic layout is for preliminary design. For actual design see Attachments B, C, D and E.

Attachment A (cont.)

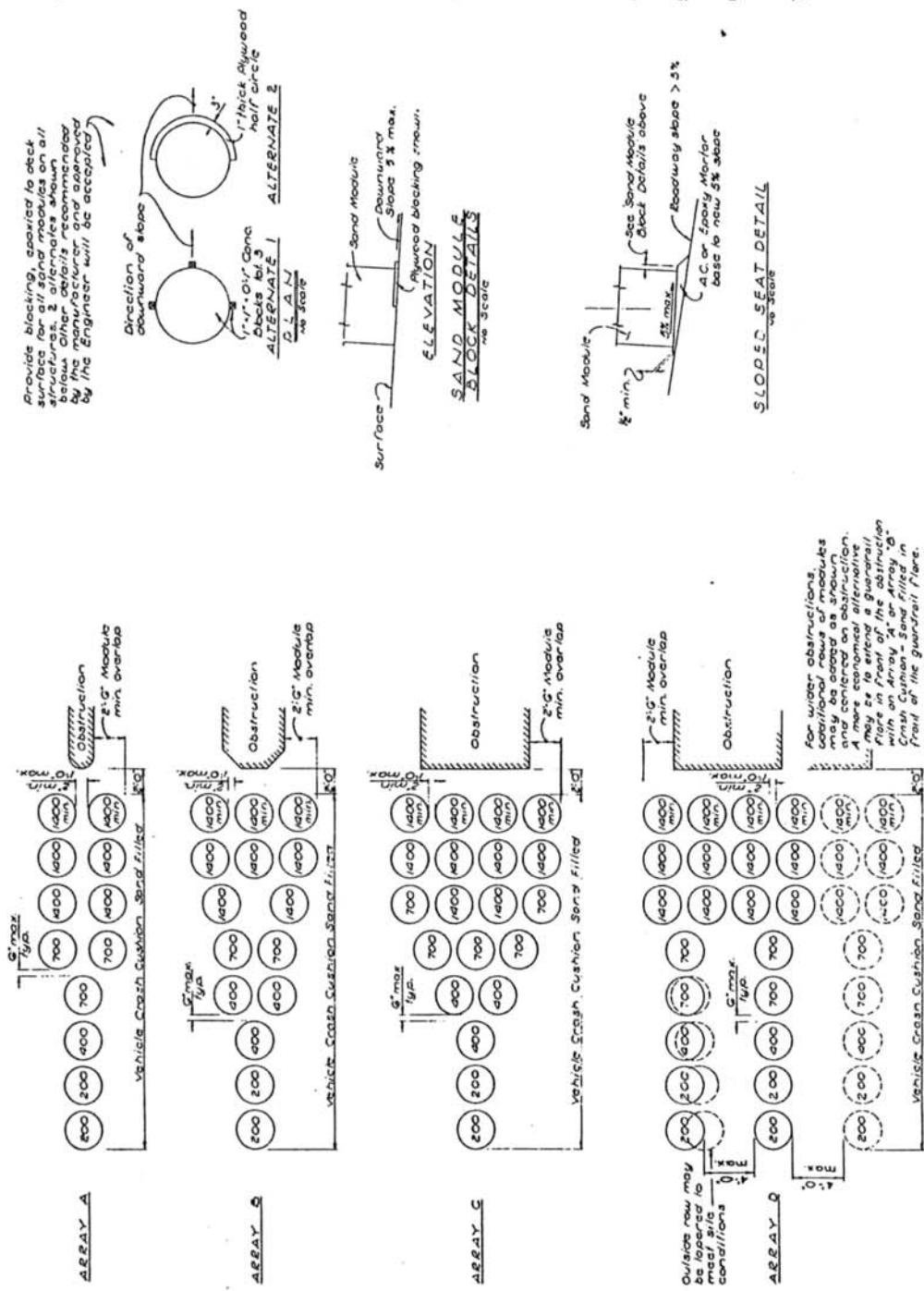


Figure 1
Various Crash Cushions

Sand Barrels



Hex-Foam



provide blocking, eaved to deck surface for all sand modules on all structures. 2 alternatives shown below. Other details recommended by the manufacturer and approved

mm	g/m³
0.5	200
1.0	400
1.5	700
2.0	700
2.5	1000
3.0	1000
4.0	1000
5.0	1000
6.0	1000
7.0	1000
8.0	1000
9.0	1000
10.0	1000

The diagram illustrates the relationship between three concepts:

- 2:G Modulus min. overlap**: A horizontal bar at the top representing a range from 0 to 1000 mm.
- Obstruction**: A shaded rectangular area below the modulus range, representing a specific height level.
- Vehicle Ground Cushion Sand Filled**: A series of circles arranged in two rows, representing a height range from 0 to 1000 mm.

A vertical line labeled ΔH_{min} connects the bottom of the 'Obstruction' box to the top of the first circle in the 'Vehicle Ground Cushion Sand Filled' row. Another vertical line labeled G_{max} connects the top of the 'Obstruction' box to the top of the second circle in the 'Vehicle Ground Cushion Sand Filled' row. The bottom of the 'Vehicle Ground Cushion Sand Filled' row is labeled ΔH_{max} .

Text to the right of the diagram provides context:

For winter obstacle visibility, a longer distance is more economical. A more economical way may be to extend a plane in front of the vehicle on an array of crash cushion - sand.

GENERAL NOTES

1. (700) Indicates module location and weight of sand in each module.

2. All sand weights are nominal.

3. Where a module is indicated "1400 Min.", that module is to contain 1,400 lbs. of sand supported according to the manufacturer's instructions. Sand should reach the top of module.

Where a module is noted as containing 2100 lbs. of sand, the module should be completely full of sand. Either manufacturer's module shell or container may be used. Open bottom shell must use a liner or seal to prevent sand leakage.

4. Design criteria for Array "A" is 65 M.P.H. The other Arrays will satisfy this condition.

5. Designs to meet greater or less speeds will vary from those Arrays indicated.

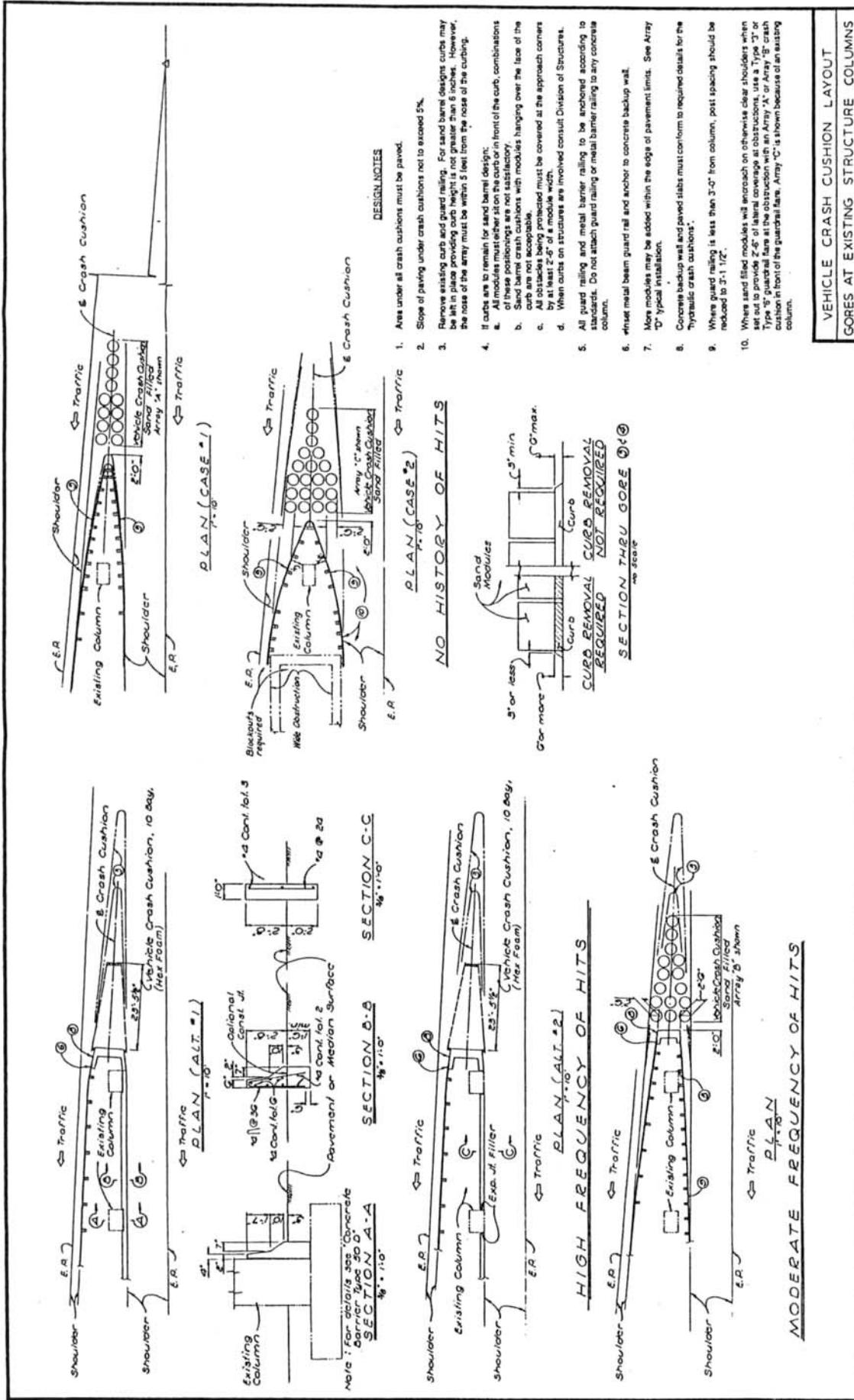
6. Installation may be angled toward approaching traffic when traffic approaches on one side only. Amount of angle not to exceed 10°.

7. Install a Type R marker on the lead module of all crash cushions where approaching traffic may pass to either side of the crash cushion. Where traffic may pass to only one of the crash cushion, a Type P marker should be used instead. Type P markers may be used on the outer modules where the approach is several modules wide and traffic may pass to either side such as for Arry "D".

DESIGN GUIDE

CRASH CUSHION - SAND FILLED

TYPICAL INSTALLATIONS



JANUARY 1989

MEMO TO DESIGNERS

